Final

Site Investigation Report
Ranges South of Range 25, Parcels 224Q, 226Q, and 227Q

Fort McClellan
Calhoun County, Alabama

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Table of Contents

Table of Contents *(Continued)*

Page

List of Appendices

List of Tables

List of Figures

Executive Summary

In accordance with Contract Number DACA21-96-D-0018, Task Order CK10, IT Corporation completed a site investigation (SI) at the Ranges South of Range 25, Parcels 224Q, 226Q, and 227Q, at Fort McClellan (FTMC) in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site, and, if present, whether the concentrations present an unacceptable risk to human health or the environment. The SI at the Ranges South of Range 25 consisted of the sampling and analysis of 22 surface soil samples, 8 depositional soil samples, 22 subsurface soil samples, 5 surface water and sediment samples, and 5 groundwater samples. In addition, six permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information.

Chemical analysis of samples collected at the Ranges South of Range 25 indicates that only metals were detected in site media. Explosive compounds were not detected in any of the samples collected at the site. To evaluate whether the detected constituents pose an unacceptable risk to human health or the environment, the analytical results were compared to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. A preliminary risk assessment was also performed to further characterize the potential threat to human health.

The potential threat to human receptors is expected to be low. Although the site is projected for passive recreation reuse, the analytical data were evaluated against a residential reuse scenario to determine if the site is suitable for unrestricted reuse. Chemicals of potential concern were limited to metals in soils and groundwater for the residential reuse scenario. No chemicals of potential concern were selected for the recreational site user scenario. The preliminary risk assessment concluded, however, that exposure to site media does not pose an unacceptable risk for either the resident or the recreational site user.

Constituents of potential ecological concern were limited to three metals (antimony, beryllium, and lead) in surface soils and one metal (arsenic) in one sediment sample. Antimony was detected at estimated concentrations (4.38 and 4.41 milligrams per kilogram [mg/kg]) marginally exceeding its ESV (3.5 mg/kg) and upper background range (2.6 mg/kg) in two surface soil samples. Antimony was not detected in the remaining 28 surface and depositional soil samples. Beryllium concentrations (1.14 to 1.64 mg/kg) marginally exceeded its ESV (1.1 mg/kg) and

upper background range (0.87 mg/kg) in five surface soil samples. It is likely that the beryllium results reflect naturally occurring levels. Lead (135 mg/kg) exceeded its ESV (50 mg/kg) and upper background range (83 mg/kg) in only one of 30 surface and depositional soil samples. Statistically, one elevated lead result out of 30 samples is not representative of nominal site-wide levels. In sediment, arsenic was detected at an estimated concentration (43.9 mg/kg) exceeding its ESV (7.24 mg/kg) and upper background range (20 mg/kg) in one sample. Based on the relatively small magnitude of the exceedances and/or limited spatial distribution in site media, these metals are not expected to pose a threat to ecological receptors.

Based on the results of the SI, past operations at the Ranges South of Range 25 do not appear to have adversely impacted the environment. The metals detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, IT Corporation recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste for the area of investigation at the Ranges South of Range 25, Parcels 224Q, 226Q, and 227Q.

1.0 Introduction

The U.S. Army has selected Fort McClellan (FTMC) located in Calhoun County, Alabama, for closure by the Base Realignment and Closure (BRAC) Commission under Public Laws 100-526 and 101-510. The 1990 Base Closure Act, Public Law 101-510, established the process by which U.S. Department of Defense (DOD) installations would be closed or realigned. The BRAC Environmental Restoration Program requires investigation and cleanup of federal properties prior to transfer to the public domain. The U.S. Army is conducting environmental studies of the impact of suspected contaminants at parcels at FTMC under the management of the U.S. Army Corps of Engineers (USACE), Mobile District. The USACE contracted IT Corporation (IT) to perform the site investigation (SI) at the Former Pistol Range South of Range 25, Parcel 224Q; Former Machine Gun Range, Parcel 226Q; and Former Pistol Range, Parcel 227Q, under Contract Number DACA21-96-D-0018, Task Order CK10. The parcels are hereinafter referred to collectively as the Ranges South of Range 25.

The area investigated in this SI includes almost all of Parcel 224Q and small portions (firing line areas) of Parcels 226Q and 227Q. In addition, all or portions of ten other unnamed ranges were included in this SI. The area of investigation depicted herein was modified from that presented in the SI work plan because of contamination. Specifically, approximately 6 acres in the northeast portion of the area of investigation were excluded from the SI because of metals contamination (particularly lead) in surface soils. The excluded portion of the area of investigation will be investigated as part of the Baby Bains Gap Road Engineering Evaluation/Cost Analysis (EE/CA).

This report presents specific information and results compiled from the SI, including field sampling and analysis and monitoring well installation activities conducted at the Ranges South of Range 25.

1.1 Project Description

Parcels 224Q, 226Q, and 227Q were areas identified for investigation prior to property transfer. The parcels were classified as Category 1 Qualified parcels in the environmental baseline survey (EBS) (Environmental Science and Engineering, Inc. [ESE], 1998). Category 1 parcels are areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas). The parcels, however, were qualified because of their use as weapons ranges.

A site-specific field sampling plan (SFSP) (IT, 2001) and a site-specific safety and health plan (SSHP) were finalized in June 2001. The SFSP and SSHP were prepared to provide technical guidance for sample collection and analysis at the Ranges South of Range 25. The SFSP was used in conjunction with the SSHP as attachments to the installation-wide work plan (IT, 1998), and the installation-wide sampling and analysis plan (SAP) (IT, 2000a). The SAP includes the installation-wide safety and health plan and quality assurance plan.

The SI included fieldwork to collect 22 surface soil samples, 8 depositional soil samples, 22 subsurface soil samples, 5 surface water samples, 5 sediment samples, and 5 groundwater samples. Data from the field investigation were used to determine whether potential site-specific chemicals are present at the Ranges South of Range 25.

1.2 Purpose and Objectives

The SI program was designed to collect data from site media and provide a level of defensible data and information in sufficient detail to determine whether chemical constituents are present at the Ranges South of Range 25 at concentrations that present an unacceptable risk to human health or the environment. The conclusions of the SI in Chapter 6.0 are based on the comparison of the analytical results to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. The SSSLs and ESVs were developed by IT as part of the human health and ecological risk evaluations associated with SIs being performed under the BRAC Environmental Restoration Program at FTMC. The SSSLs and ESVs are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000b). Background metals screening values are presented in the *Final Background Metals Survey Report, Fort McClellan, Alabama* (Science Applications International Corporation [SAIC], 1998).

Based on the conclusions presented in this SI report, the BRAC Cleanup Team will decide either to propose "No Further Action" at the site or to conduct additional work at the site.

1.3 Site Description and History

The Ranges South of Range 25 are located in the central area of the FTMC Main Post (Figure 1-1). The area of investigation for this SI is shown on Figure 1-2. Parcels 224Q, 226Q, and 227Q are the primary ranges of concern for the area of investigation as defined in the EBS (ESE, 1998). The impact areas of these ranges extend beyond the area of investigation for this SI and will be included in the Baby Bains Gap Road EE/CA.

Parcel 224Q. Parcel 224Q was identified on the 1937 General Map of FTMC as a pistol range south of Range 25 (Figure 1-2). The surface danger zone, or range fan, was not identified for Parcel 224Q, and the direction of fire is unknown. The firing direction for the range was likely to the east or to the south, and the impact area is probably within the area of investigation for this SI. A berm that runs northeast-southwest across the eastern boundary of the parcel may have been the backstop for the range. The impact area likely would not have been to the north because of the location of Range 25. Also, the direction of fire likely would not have been to the west towards the main cantonment.

Parcel 224Q is approximately 375 feet by 675 feet. From aerial photographs taken in 1944, the Former Pistol Range South of Range 25 (Parcel 224Q) appears as a large clearing surrounded by sparse ground vegetation. Bains Gap Road runs east-west through the northern portion of the parcel, and a tributary of Ingram Creek flows west through the center of the parcel. The ground elevation of Parcel 224Q ranges from approximately 825 to 845 feet above mean sea level (msl). The ground surface slopes to the northwest. There is no other information available regarding this range for dates of use or operation activities (ESE, 1998).

Parcel 226Q. The Former Machine Gun Range, Parcel 226Q, is identified south of Range 25 on the 1946 Reservation Map. Based on the range fan presented in the EBS, the direction of fire was to the southeast. The 1946 Reservation Map provides the only documentation of this range. The parcel boundary extends in a fan shape to the southeast and overlaps most of Range 23 (Figure 1-2). The elevation of the Former Machine Gun Range, Parcel 226Q, ranges from approximately 830 to 860 feet above msl in the area of investigation. The impact area for Parcel 226Q, as depicted in the EBS, appears to be to the southeast, beyond the area of investigation and in the impact area for Range 23. No other information was available regarding this range, dates of use, or operation (ESE, 1998).

Parcel 227Q. The Former Pistol Range, Parcel 227Q, is identified on the 1946 Reservation Map as Range 23. The direction of fire was nearly due east, according to information in the EBS. Pistol ranges are identified in this general area on other maps. Aerial photographs taken in 1944 show the firing line area as a rectangular clearing on the western end of the parcel. Ingram Creek transects the Former Pistol Range, Parcel 227Q, flowing to the northwest. The parcel boundary extends to the east and overlaps Range 23 (Figure 1-2). The elevation of the Former Pistol Range, Parcel 227Q, ranges from approximately 840 to 870 feet above msl in the area of investigation. The impact area for Parcel 227Q, as depicted in the EBS, appears to be to the southeast, beyond the area of investigation and in the impact area for Range 23. No other information was available regarding this range or its operation (ESE, 1998).

Unnamed Ranges. In addition to Parcels 224Q, 226Q, and 227Q, described in the EBS, ten other ranges (areas) are included within the SI area of investigation based on information in the *Archives Search Report, Maps, Fort McClellan, Anniston, Alabama (ASR)* (USACE, 2001). These ranges were not described in the EBS. Figures 1-3 through 1-6, taken from the ASR map plates, show the additional ranges (A through J) within the area of investigation. Most of the ranges are not named or described in the ASR. Each of the plates in the ASR represents a different period of use at FTMC. The periods of use corresponding to the ASR plates include:

- Plate 4 – Inter-War Range Use (World War I to World War II)
- Plate 5 – World War II to 1950 Range Use
- Plate 6 – 1950 to 1973 Range Use
- Plate 10 – Cumulative Map of All Ranges.

1.3.1 Archives Search Report Maps

The following paragraphs provide brief descriptions of the unnamed ranges shown on the ASR plates and included within the SI area of investigation.

Plate 4 of the ASR. Plate 4 of the ASR shows three ranges in the area of investigation. Former Range 23 (Unnamed Range A) appears to be an early orientation of Range 23 that extends on both the north and south sides of Snap Lane (Figure 1-3). Unnamed Range A was represented on ASR Plate 4 as approximately 800 feet by 1,600 feet in size. According to the ASR, Former Range 23 began in the inter-war period as a pistol range and later changed to rifle and machine gun ranges. Range maps indicate that the Range 23 layout changed often with different orientations, and the orientation of Range 23 on Plate 4 appears to be farther northwest than the Range 23 location given in the EBS. Based on the orientation of the range area in the EBS, the impact area may be partially within the area of investigation but also may extend across Snap Lane into the area of Range 23 (Figure 1-3). Any impact area existing within Range 23 will be included in the Baby Bains Gap Road EE/CA.

Unnamed Range B shown on Plate 4 of the ASR is labeled as a pistol range and is oriented northeast-southwest, overlapping the northwestern portion of Parcel 224Q (Figure 1-3).

Unnamed Range B was depicted as approximately 250 feet by 1,000 feet in size. The likely direction of fire would have been to the southeast. The impact area may be along the southeast border toward the existing berm and within the area of investigation.

Unnamed Range C (approximately 100 feet by 600 feet) shown on Plate 4 of the ASR is east of, and roughly parallel to, Parcel 224Q. The range is generally oriented north-south. The firing direction would have been to the east. The impact area may likely be along the southern or eastern border of Parcel 226Q within the eastern boundary of the area of investigation.

Plate 5 of the ASR. Plate 5 of the ASR shows three unnamed ranges (D, E, and F) (Figure 1-4). Unnamed Range D (approximately 100 feet by 600 feet) overlaps Parcel 224Q on the east and is oriented northeast-southwest. Unnamed Range E is roughly parallel to Unnamed Range D and overlaps the southeastern corner of Parcel 224Q. Unnamed Range E (approximately 150 feet by 850 feet) is slightly larger than Unnamed Range D and is also oriented northeast-southwest. Unnamed Range F is oriented west-east, similar to Parcel 227Q. Plate 5 of the ASR appears to show a firing line area as well as the range fan for Unnamed Range F that overlaps the range fan for Parcel 227Q and may be intended to represent Parcel 227Q. The impact area for Unnamed Ranges D and E may likely be within the SI area of investigation. The impact area for Unnamed Range F appears to be east of Snap Lane in the area of Range 23 and outside of the area of investigation (Figure 1-4).

Plate 6 of the ASR. Plate 6 of the ASR shows three unnamed ranges (G, H, and I) (Figure 1-5). Unnamed Range G is oriented northeast-southwest. Plate 6 appears to show the firing line area and the range fan in almost the same location as Parcel 226Q. Unnamed Range H is oriented west-east and appears to be about twice as large as Parcel 227Q. This range fan may be intended to represent Parcel 227Q. Only the firing line area of Unnamed Range H is located within the present area of investigation. Unnamed Range I is located to the south of Unnamed Range H and is also oriented west-east. Only a very small portion of Unnamed Range I is located within the area of investigation. The impact areas for all three of the ranges shown on Plate 6 of the ASR are beyond the area of investigation in the area of Range 23.

Plate 10 of the ASR. Plate 10 of the ASR is the cumulative map of all ranges. However, of the unnamed ranges previously described, only Unnamed Ranges A, B, and C are shown on Plate 10 (Figure 1-6). Plate 10 also shows an unnamed range (J) not shown on the previous ASR plates. This range appears to be in the same general area as the firing line area for Parcel 227Q, but no range fan is shown. The range is depicted on Plate 10 as approximately 100 feet by 300 feet in size. Additional information was not available for Unnamed Range J. The impact area for this range is likely to the east toward Snap Lane, within the southern portion of the area of investigation. However, if it is intended to represent Parcel 227Q, the impact area would be toward Range 23 and outside of the present area of investigation.

1.3.2 Aerial Photographs

Available aerial photographs were reviewed to reveal land-use activity in the area of investigation, and attempts were made to correlate the review of the photographs with information in the ASR. The following is a summary of the review of the available aerial photographs for this area. Several photographs were excluded from this presentation either because they were of poor quality or because they did not show significant differences from the photographs discussed below.

1937. The 1937 aerial photograph shows the southern half of the area of investigation to be wooded and the northern portion to be cleared. The cleared area extends the length of Parcel 224Q. Due to lack of photo clarity, it is difficult to discern if any range activity was being conducted east of Parcel 224Q in the area of Parcel 226Q. The area of the probable firing line for Parcel 226Q is cleared and some dirt roads cross the area.

Parcel 227Q was wooded at the time of the 1937 aerial photograph. Ranges shown on the ASR Plate 4 for this time period that could potentially match the active areas shown on the 1937 aerial photograph are Unnamed Ranges A and C. It is apparent on the 1937 aerial photograph that Range 25 to the north of the study area was an active range.

1940. The 1940 aerial photograph (Figure 1-7) shows no obvious change to the area of investigation compared with the 1937 aerial photograph. Both the 1937 and 1940 aerial photographs were taken during the Inter-War Period of range use at FTMC, as represented by Plate 4 of the ASR.

1944. The 1944 aerial photograph (Figure 1-8) shows evidence of increased activity within the area of investigation and expanded land use in the area east of Parcel 224Q, probably the firing line area for Parcel 226Q. The activity appears more related to the area of Parcel 226Q than to Parcel 224Q. Two or three buildings are present near the center of Parcel 224Q, which may be associated with range activities at Parcel 226Q. These building locations may correspond to the concrete slabs observed during the IT site walk in March 2001. Perpendicular berms (or target lines) downrange of the probable firing line are observed within Parcel 226Q. These shapes also match the firing line area for Unnamed Range G shown on Plate 6 of the ASR (1950 to 1973) in Figure 1-5.

Clearing has begun in the area that matches the probable firing line for Parcel 227Q in the area of Unnamed Range I (Figure 1-5).

1954. Land-use activity shown in this aerial photograph is similar to the 1944 photograph, with the areas of use being more distinct (Figure 1-9). Unnamed Range H has a V-shaped firing line area. It may be that Unnamed Range H represents two ranges, one being Parcel 227Q. The V-shaped firing line area may be a result of the buffer of tall trees separating two heavy-use areas. There is another area of land-use activity shown on the 1954 aerial photograph that matches Unnamed Range I, which is located south of Unnamed Range H.

1961. This aerial photograph shows distinct land-use activity within the area of investigation, with present-day roads evident throughout the area. Buildings have been constructed near the southern portion of the firing line area of Parcel 226Q. The rest of the study area appears similar to the 1954 aerial photograph, except for land-use activity in the area of Range 23, just east of the study area. There had not been any evidence of activity in the area of Range 23 until the 1961 photograph, although Range 23 reportedly had been in use since 1951 (ESE, 1998). This may indicate that the ranges at Parcels 226Q and 227Q were no longer in use in 1961, because the line of fire would have been to the south and east, toward Range 23.

1964. This aerial photograph clearly shows Range 23, just east of the study area, as an active range. It is not likely that any ranges within the study area are active at this time, due to the proximity of Range 25 to the north, Range 23 to the east and southeast, and the main cantonment to the west. An increase in tree growth is observed in the previous heavy-use areas of Parcel 227Q and further south toward Snap Lane.

1969. This aerial photograph appears similar to the 1964 photograph. Some continued land-use activity is observed in the areas of Parcels 224Q and 226Q. The remaining portions of the area of investigation appear to be increasingly reclaimed by vegetation and trees. Range 23 to the east and Range 25 to the north continue to appear active.

1973. The 1973 aerial photograph (Figure 1-10) appears very similar to the 1969 photograph. Most of the areas in the study area have increased vegetation and tree growth, with the exception of the northwestern corner of the study area in Parcel 226Q. This clearing is mostly in the area of the probable firing line of Parcel 226Q, which still appears to be utilized, perhaps as a training area or bivouac area.

1976, 1994, and 1998. These aerial photographs show little land-use activity in the study area, except for the two buildings west of Snap Lane and south of Range 23. There is increased vegetation and tree cover in the study area. Ranges 23 and 25, which are outside of the study area, continue to appear very active. Also, land-use activity in the area of Range 26, east of the study area, appears in the 1976 aerial photograph and becomes more evident in the subsequent photographs.

1.3.3 SI Site Visit

During site walks conducted by IT personnel in March and June 2001, several surface features were noted (Figure 1-2). Most of the area of investigation is densely wooded. Along the firing line for the Former Machine Gun Range, Parcel 226Q, was a berm approximately 10 to 18 feet wide, with 3-foot pipes and railroad ties running its length. This berm appears more like a firing line than an impact area and may have been the firing line for the Former Machine Gun Range, Parcel 226Q. A firebreak extends south from Bains Gap Road midway through Parcel 224Q and bends west toward Ingram Creek. Two concrete slabs, approximately 25 by 36 feet, were also observed in the northern portion of the area of investigation. A mound with broken concrete was located about 50 feet west of the larger concrete slab. Additionally, a 12-foot by 4-foot trench was noted immediately west of Parcel 224Q (Figure 1-2).

A large cleared area containing bullet fragments is in the center of the probable firing area for Parcel 226Q, just east of Parcel 224Q. Just southwest of this bare area, there is a metal rail that was possibly used to maneuver targets. A long, natural embankment is present southwest of the bare area and appears to have been used as an impact area.

Two low berms, oriented north-south, were observed south of Parcel 227Q. The longer berm extends south of Snap Lane. Numerous shallow depressions and shallow trenches were also observed throughout the area of investigation and may have been used for defensive position training. From observations during the site walks, it appeared that the area of investigation had been used in recent years for bivouac or defensive training activities rather than for range activities.

2.0 Previous Investigations

An EBS was conducted by ESE to document current environmental conditions of all FTMC property (ESE, 1998). The study was to identify sites that, based on available information, have no history of contamination and comply with DOD guidance for fast-track cleanup at closing installations. The EBS also provides a baseline picture of FTMC properties by identifying and categorizing the properties by seven criteria:

1. Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas).

2. Areas where only release or disposal of petroleum products has occurred.

3. Areas where release, disposal, and/or migration of hazardous substances has occurred, but at concentrations that do not require a removal or remedial response.

4. Areas where release, disposal, and/or migration of hazardous substances has occurred, and all removal or remedial actions to protect human health and the environment have been taken.

5. Areas where release, disposal, and/or migration of hazardous substances has occurred, and removal or remedial actions are underway, but all required remedial actions have not yet been taken.

6. Areas where release, disposal, and/or migration of hazardous substances has occurred, but required actions have not yet been implemented.

7. Areas that are not evaluated or require additional evaluation.

For non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) environmental or safety issues, the parcel label includes the following components: a unique non-CERCLA issue number, the letter "Q" designating the parcel as a Community Environmental Response Facilitation Act (CERFA) Category 1 Qualified Parcel, and the code for the specific non-CERCLA issue(s) present (ESE, 1998). The non-CERCLA issue codes used are:

- A = Asbestos (in buildings)
- L = Lead-Based Paint (in buildings)
- P = Polychlorinated Biphenyls

- R = Radon (in buildings)
- RD = Radionuclides/Radiological Issues
- X = Unexploded Ordnance
- CWM = Chemical Warfare Material.

The EBS was conducted in accordance with CERFA protocols (CERFA-Public Law 102-426) and DOD policy regarding contamination assessment. Record searches and reviews were performed on all reasonably available documents from FTMC, the Alabama Department of Environmental Management (ADEM), the U.S. Environmental Protection Agency (EPA) Region IV, and Calhoun County, as well as a database search of CERCLA-regulated substances, petroleum products, and Resource Conservation and Recovery Act-regulated facilities. Available historical maps and aerial photographs were reviewed to document historical land uses. Personal and telephone interviews of past and present FTMC employees and military personnel were conducted. In addition, visual site inspections were conducted to verify conditions of specific property parcels.

Parcels 224Q, 226Q, and 227Q were identified as Category 1 CERFA sites: areas where no known or recorded storage, release, or disposal (including migration) has occurred on site property. The parcels, however, were qualified because of their use as weapons ranges. Therefore, the parcels required additional evaluation to determine their environmental condition.

3.0 Current Site Investigation Activities

This chapter summarizes SI activities conducted by IT at the Ranges South of Range 25, including unexploded ordnance (UXO) avoidance, environmental sampling and analysis, and groundwater monitoring well installation activities.

3.1 UXO Avoidance

UXO avoidance was performed at the Ranges South of Range 25 following methodology outlined in Section 4.1.7 of the SAP (IT, 2000a). IT UXO personnel used a low-sensitivity magnetometer to perform a surface sweep of the area of investigation prior to site access. After the area was cleared for access, sample locations were monitored following procedures outlined in Section 4.1.7.3 of the SAP (IT, 2000a).

3.2 Environmental Sampling

Environmental sampling performed during the SI at the Ranges South of Range 25 included collection of surface and depositional soil samples, subsurface soil samples, groundwater samples, and surface water/sediment samples for chemical analyses. Sample locations were determined by observing site physical characteristics during a site walkover and by reviewing historical documents and aerial photographs. The sample locations, media, and rationale are summarized in Table 3-1. A summary of the numbers of samples collected in each medium within each parcel is presented in Table 3-2. Sampling locations are shown on Figure 3-1. Samples were submitted for laboratory analysis of site-related parameters listed in Section 3.4. IT contracted Environmental Services Network, Inc, a direct-push technology (DPT) subcontractor, to assist in surface and subsurface soil sample collection.

3.2.1 Surface and Depositional Soil Sampling

Surface soil samples were collected from 22 locations and depositional soil samples were collected from eight locations at the Ranges South of Range 25, as shown on Figure 3-1. Soil sampling locations and rationale are presented in Table 3-1. Sample designations and analytical parameters are listed in Table 3-3. Soil sampling locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Surface soil samples were collected from the uppermost foot of soil using a DPT sampling system, following the methodology specified in Section 4.9.1.1 of the SAP (IT, 2000a). Depositional soil samples were collected from the upper six inches of soil with a stainless-steel spoon. Surface and depositional soil samples were collected by first removing surface debris (e.g., rocks and vegetation) from the immediate sample area. The soil was collected with the sampling device and screened with a photoionization detector (PID) in accordance with Section 4.7.1.1 of the SAP (IT, 2000a). The soil was then transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-3 using methods outlined in Section 3.4.

3.2.2 Subsurface Soil Sampling

Subsurface soil samples were collected from 22 soil borings at the Ranges South of Range 25, as shown on Figure 3-1. Subsurface soil sampling locations and rationale are presented in Table 3-1. Subsurface soil sample designations, depths, and analytical parameters are listed in Table 3-3. Soil boring sampling locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Subsurface soil samples were collected from soil borings at depths greater than one foot below ground surface (bgs) in the unsaturated zone. The soil borings were advanced and samples collected using the DPT sampling procedures specified in Section 4.9.1.1 of the SAP (IT, 2000a). Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-3 using methods outlined in Section 3.4.

Subsurface soil samples were collected continuously to 12 feet bgs or until DPT sampler refusal was encountered. Samples were field screened using a PID in accordance with Section 4.7.1.1 of the SAP (IT, 2000a) to measure for volatile organic vapors. The sample displaying the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were not greater than background, the deepest sample interval above the saturated zone was submitted for analysis. The soil was then transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist constructed a detailed boring log for each soil boring. The boring logs are included in Appendix B. At the completion of soil sampling, boreholes were abandoned with bentonite pellets and hydrated with potable water, following borehole abandonment procedures summarized in Appendix B of the SAP (IT, 2000a).

3.2.3 Monitoring Well Installation

Six permanent groundwater monitoring wells were installed in the saturated zone at the Ranges South of Range 25, to collect groundwater samples for laboratory analysis. The well locations are shown on Figure 3-1. Table 3-4 summarizes construction details of the wells installed at the Ranges South of Range 25. The well construction logs are included in Appendix B.

IT contracted Miller Drilling Company to install the permanent wells with a hollow-stem auger drilling rig. IT attempted to install the wells at six of the DPT soil boring locations; however, this was not possible at one location (HR-227Q-MW03) because auger refusal was encountered prior to reaching groundwater. Therefore, the well was offset approximately 180 feet south of the DPT soil boring location. The wells were installed following procedures outlined in Section 4.7 and Appendix C of the SAP (IT, 2000a). The borehole at each well location was advanced with a 4.25-inch inside diameter (ID) hollow-stem auger from ground surface to the saturated zone. The borehole was augered to the completion depth of the DPT boring, and samples were collected from that depth to the bottom of the borehole. A 2-foot-long, 2-inch ID carbon steel split-spoon sampler was driven at 5-foot intervals to collect residuum for observing and describing lithology. The drill cuttings were logged to determine lithologic changes and the approximate depth of groundwater encountered during drilling. This information was used to determine the optimal placement of the monitoring well screen interval and to provide site-specific geological and hydrogeological information. The boring log for each borehole is included in Appendix B.

Upon reaching the target depth in each borehole, a 5- to 15-foot-length of 2-inch ID, 0.010-inch continuous slot, Schedule 40 polyvinyl chloride (PVC) screen with end cap was placed through the auger to the bottom of the borehole. The screen and end cap were attached to 2-inch ID, flush-threaded Schedule 40 PVC riser. A filter pack consisting of number 1 filter sand (environmentally safe, clean fine sand, sieve size 20 to 40) was tremied around the well screen to approximately 3 feet above the top of the well screen as the augers were removed. A bentonite seal, consisting of approximately 3 feet of bentonite pellets, was placed immediately on top of the filter sand and hydrated with potable water. At wells where the bentonite seal was installed below the water table surface, the bentonite pellets were allowed to hydrate in the groundwater. The bentonite seal placement and hydration followed procedures in Appendix C of the SAP (IT, 2000a). As appropriate, bentonite-cement grout was tremied into the remaining annular space of the well. A protective steel casing was placed over the PVC well casing, and a concrete pad was constructed around the well. Four protective steel posts were installed around the well pad.

Five of the six monitoring wells installed were developed by surging and pumping with a 2-inch-diameter submersible pump in accordance with methodology outlined in Section 4.8 and Appendix C of the SAP (IT, 2000a). The submersible pump used for well development was moved in an up-and-down fashion to encourage any residual well installation materials to enter the well. These materials were then pumped out of the well in order to re-establish the natural hydraulic flow conditions. Development continued until the water turbidity was less than 20 nephelometric turbidity units, or for a maximum of eight hours. Monitoring well HR-227Q-MW03 was not developed because it was dry. The well development logs are included in Appendix C.

3.2.4 Water Level Measurements

The depth to groundwater was measured in the permanent wells at the site on January 8, 2002, following procedures outlined in Section 4.18 of the SAP (IT, 2000a). Depth to groundwater was measured with an electronic water level meter. The meter probe and cable were cleaned before use at each well, following decontamination methodology presented in Section 4.10 of the SAP (IT, 2000a). Measurements were referenced to the top of the PVC well casing. A summary of groundwater level measurements for the Ranges South of Range 25 is presented in Table 3-5.

3.2.5 Groundwater Sampling

Groundwater samples were collected from five of the six wells installed at the Ranges South of Range 25. Monitoring well HR-227Q-MW03 was not sampled because the well was dry. The well/groundwater sampling locations are shown on Figure 3-1. The groundwater sampling locations and rationale are listed in Table 3-1. The groundwater sample designations and analytical parameters are listed in Table 3-6.

Sample Collection. Groundwater samples were collected using either a peristaltic pump or a bladder pump equipped with Teflon™ tubing, following the procedures outlined in Section 4.9.1.4 of the SAP (IT, 2000a). Groundwater samples were collected after purging a minimum of three well volumes and after field parameters (temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity) stabilized. Field parameters were measured using a calibrated water-quality meter. Field parameter readings are summarized in Table 3-7. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-6 using methods outlined in Section 3.4.

3.2.6 Surface Water Sampling

Five surface water samples were collected at the Ranges South of Range 25, at the locations shown on Figure 3-1. The surface water sampling locations and rationale are listed in Table 3-1. Surface water sample designations and analytical parameters are listed in Table 3-8. The actual sampling locations were determined in the field, based on drainage pathways and field observations.

Sample Collection. Surface water samples were collected in accordance with the procedures specified in Section 4.9.1.3 of the SAP (IT, 2000a). The surface water samples were collected by dipping a stainless-steel pitcher in the water and pouring the water into the sample containers. Surface water samples were collected after field parameters had been measured using a calibrated water quality meter. Surface water field parameters are listed in Table 3-7. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-8 using methods outlined in Section 3.4.

3.2.7 Sediment Sampling

Five sediment samples were collected at the same locations as the surface water samples, as shown on Figure 3-1. Sediment sampling locations and rationale are presented in Table 3-1. The sediment sample designations and analytical parameters are listed in Table 3-8. The actual sediment sampling locations were determined in the field, based on drainage pathways and field observations.

Sample Collection. Sediment samples were collected in accordance with the procedures specified in Section 4.9.1.2 of the SAP (IT, 2000a). Sediments were collected with a stainless-steel spoon and placed in a clean stainless-steel bowl. The sample was homogenized and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The sediment samples were analyzed for the parameters listed in Table 3-8 using methods outlined in Section 3.4.

3.3 Surveying of Sample Locations

Sample locations were surveyed using global positioning system survey techniques described in Section 4.3 of the SAP and conventional civil survey techniques described in Section 4.19 of the SAP (IT, 2000a). Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American Datum of 1983. Elevations were referenced to the

North American Vertical Datum of 1988. Horizontal coordinates and elevations are included in Appendix D.

3.4 Analytical Program

Samples collected during the SI were analyzed for various chemical parameters based on potential site-specific chemicals and on EPA, ADEM, FTMC, and USACE requirements. Samples collected at the Ranges South of Range 25 were analyzed for the following parameters:

- Target analyte list metals – EPA Method 6010B/7000
- Nitroaromatic and nitramine explosives – EPA Method 8330.

In addition, the sediment samples were analyzed for the following list of parameters:

- Total organic carbon – EPA Method 9060
- Grain size – American Society for Testing and Materials D-422.

The samples were analyzed using EPA SW-846 methods, including Update III Methods where applicable, as presented in Table 6-1 in Appendix B of the SAP (IT, 2000a).

3.5 Sample Preservation, Packaging, and Shipping

Sample preservation, packaging, and shipping followed requirements specified in Section 4.13.2 of the SAP (IT, 2000a). Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SI are listed in Table 5-1 of Appendix B of the SAP (IT, 2000a). Sample documentation and chain-of-custody records were completed as specified in Section 4.13 of the SAP (IT, 2000a).

Completed analysis request and chain-of-custody records (Appendix A) were secured and included with each shipment of sample coolers to EMAX Laboratories, Inc. in Torrance, California.

3.6 Investigation-Derived Waste Management and Disposal

Investigation-derived waste (IDW) was managed and disposed as outlined in Appendix D of the SAP (IT, 2000a). The IDW generated during the SI at the Ranges South of Range 25 was segregated as follows:

- Drill cuttings

- Purge water from well development, sampling activities, and decontamination fluids

- Personal protective equipment.

Solid IDW was stored inside the fenced area surrounding Buildings 335 and 336 in lined roll-off bins prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure analyses. Based on the results, drill cuttings and personal protective equipment generated during the SI were disposed as nonregulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

Liquid IDW was contained in the 20,000-gallon sump associated with the Building T-338 vehicle washrack. Liquid IDW was characterized by volatile organic compound, semivolatile organic compound, and metals analyses. Based on the analyses, liquid IDW was discharged as nonregulated waste to the FTMC wastewater treatment plant on the Main Post.

3.7 Variances/Nonconformances

Six variances to the SFSP were recorded during completion of the SI at the Ranges South of Range 25. The variances did not alter the intent of the investigation or the sampling rationale presented in the SFSP (IT, 2001). The variances are summarized in Table 3-9 and the variance reports are included in Appendix E. No nonconformances were recorded during completion of the SI.

3.8 Data Quality

The field sample analytical data are presented in tabular form in Appendix F. The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI work plan; the FTMC SAP and installation-wide quality assurance plan; and standard, accepted methods and procedures. Data were reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of Appendix B of the SAP [IT, 2000a]). Chemical data were reported via hard-copy data packages by the laboratory using Contract Laboratory Program-like forms.

Data Validation. The reported analytical data were validated in accordance with EPA National Functional Guidelines by Level III criteria. The data validation results are summarized by parcel in quality assurance reports, which include the data validation summary reports (Appendix G). Selected results were qualified based on the implementation of accepted data validation procedures and practices. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC IT Environmental Management System database for tracking and reporting. The qualified data were used in comparisons to the SSSLs and ESVs developed by IT. Rejected data (assigned an “R” qualifier) were not used in the comparisons with the SSSLs and ESVs. The data presented in this report, except where qualified, meet the principle data quality objective for this SI.

4.0 Site Characterization

Subsurface investigations performed at the Ranges South of Range 25 provided soil, bedrock, and groundwater data used to characterize the geology and hydrogeology of the site.

4.1 Regional and Site Geology

4.1.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold-and-thrust structural belt (Valley and Ridge Province), where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted, with major structures and faults striking in a northeast-southwest direction.

Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults, and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992) and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984) but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper, undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish gray siltstone and mudstone. Massive to laminated greenish gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Osborne et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east, and southwest of the Main Post and consists of interlayered bluish gray or pale yellowish gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline, porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southeast of the Main Post, as mapped by Warman and Causey (1962) and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated, thinly interbedded grayish red-purple mudstone, shale, siltstone, and greenish red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962; Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al., 1997). The Conasauga Formation is composed of dark gray, finely to coarsely crystalline, medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in

Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum (Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone is comprised of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped as undifferentiated at FTMC and in other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites, and limestones and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Osborne et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark to light gray limestone with abundant chert nodules and greenish gray to grayish red phosphatic shale, with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of FTMC, to the Ordovician Athens Shale based on fossil data.

The Pennsylvanian Parkwood Formation overlies the Floyd Shale and consists of a medium to dark gray, silty, clay shale and mudstone with interbedded light to medium gray, very fine to fine grained, argillaceous, micaceous sandstone. Locally the Parkwood Formation also contains beds of medium to dark gray argillaceous, bioclastic to cherty limestone and beds of clayey coal up to a few inches thick (Raymond et al., 1988). The Parkwood Formation in Calhoun County is generally found within a structurally complex area known as the Coosa deformed belt. In the deformed belt, the Parkwood Formation and Floyd Shale are mapped as undifferentiated because their lithologic similarity and significant deformation make it impractical to map the contact (Thomas and Drahovzal, 1974; Osborne et al, 1988). The undifferentiated Parkwood Formation and Floyd Shale are found throughout the western quarter of Pelham Range.

The Jacksonville thrust fault is the most significant structural geologic feature in the vicinity of the Main Post of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama, and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984). The Ordovician sequence that makes up the Eden thrust sheet is exposed at FTMC through an eroded window, or fenster, in the overlying thrust sheet. Rocks within the window display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation; north by the Conasauga Formation; northeast, east, and southwest by the Shady Dolomite; and southeast and southwest by the Chilhowee Group (Osborne et al., 1997). Two small klippen of the Shady Dolomite, bounded by the Jacksonville fault, have been recognized adjacent to the Pell City fault at the FTMC window (Osborne et al., 1997).

The Pell City fault serves as a fault contact between the bedrock within the FTMC window and the Rome and Conasauga Formations. The trace of the Pell City fault is also exposed approximately nine miles west of the FTMC window on Pelham Range, where it traverses northeast to southwest across the western quarter of Pelham Range. Here, the trace of the Pell City fault marks the boundary between the Pell City thrust sheet and the Coosa deformed belt.

The eastern three-quarters of Pelham Range is located within the Pell City thrust sheet, while the remaining western quarter of Pelham is located within the Coosa deformed belt. The Pell City thrust sheet is a large-scale thrust sheet containing Cambrian and Ordovician rocks and is relatively less structurally complex than the Coosa deformed belt (Thomas and Neathery, 1982). The Pell City thrust sheet is exposed between the traces of the Jacksonville and Pell City faults along the western boundary of the FTMC window and along the trace of the Pell City fault on Pelham Range (Thomas and Neathery, 1982; Osborne et al., 1988). The Coosa deformed belt is a narrow northeast-to-southwest-trending linear zone of complex structure (approximately 5 to 20 miles wide and approximately 90 miles in length) consisting mainly of thin imbricate thrust slices. The structure within these imbricate thrust slices is often internally complicated by small-scale folding and additional thrust faults (Thomas and Drahovzal, 1974).

4.1.2 Site Geology

Soils within the area of investigation consist of the following two soil series (U.S. Department of Agriculture [USDA], 1961):

- Anniston and Allen gravelly loams - North-central, east, south and west portions of the area of investigation.

- Atkins silt loam - West-central portion of the study area along Ingram Creek, west of Parcel 224Q.

The Anniston and Allen Series of soils consists of friable, medium to strongly acidic, deep, well-drained soils that have developed in old local alluvium on the foot slopes and along the base of mountains. The parent material washed from the adjacent, higher-lying Linker, Muskingum, Enders, and Montevallo soils, which developed from weathered sandstone, shale, and quartzite. Sandstone and quartzite gravel, cobbles, and fragments as much as 8 inches in diameter are on the surface and throughout the soil (USDA, 1961).

The color of the surface soil ranges from dark brown and very dark brown to reddish brown and dark reddish brown. The texture of subsoil ranges from light clay loam to clay or silty clay loam. The alluvium ranges in thickness from 2 feet to more than 8 feet. Infiltration and runoff are medium, permeability is moderate, and the capacity for available moisture is high. Organic matter is moderately low. The depth to bedrock at these sites ranges from 2 feet to greater than 10 feet bgs. The depth to the water table is likely greater than 20 feet bgs (USDA, 1961).

The Atkins Series consists of poorly drained, strongly acidic soils that are developing in general alluvium. The parent material has washed mainly from soils underlain by sandstone and shale. The Atkins surface soils are dark grayish brown, mottled silt loam. The subsoils are light brownish gray to light olive-gray, mottled silt loam or clay loam. The Atkins soils occur mainly in small, narrow bands in floodplains along streams in Calhoun County. The depth to bedrock typically ranges from 2 feet to 6 feet bgs. The depth to the water table for this series is usually near the ground surface (USDA, 1961).

As shown on the site geologic map (Figure 4-1), the area of investigation is situated within the southern portion of the Ordovician eroded “window” in the uppermost structural thrust sheet at FTMC. The rocks within this window display complex folding, with the folds being overturned and tight to isoclinal. Bedrock at this site is mapped as Mississippian/Ordovician Floyd and Athens shale, undifferentiated, underlain by the Ordovician Little Oak and Newala Limestones, which are mapped as undifferentiated on FTMC (Osborne et al., 1997).

Based on the DPT and hollow-stem auger boring data collected during the SI, residuum beneath the site consists predominantly of clays with some sand or silt in places. DPT refusal ranged from one foot bgs to greater than 12 feet bgs.

During well installation activities, hollow-stem auger refusal was encountered on limestone at depths ranging from 8 to 44 feet bgs. Competent Floyd and Athens shale was not encountered; the majority of the bedrock encountered was the Little Oak and Newala Limestone, which was described on the boring logs as a medium gray, hard limestone that effervesced readily with dilute hydrochloric acid. The depth at which the limestone was encountered varies across the site; this variance is probably due to the folding that has occurred within the rocks situated in the eroded "window."

4.2 Site Hydrology

4.2.1 Surface Hydrology

Precipitation in the form of rainfall averages about 53 inches annually in Anniston, Alabama, with infiltration rates annually exceeding evapotranspiration rates (U.S. Department of Commerce, 1998). The major surface water features at the Main Post of FTMC include Remount Creek, Cane Creek, and Cave Creek. These waterways flow in a general northwest to westerly direction toward the Coosa River on the western boundary of Calhoun County.

Elevation of the Ranges South of Range 25 varies from approximately 815 to 880 feet above msl. Surface drainage at the site follows site topography and flows in a northerly and northwesterly direction. The surface runoff eventually drains into Ingram Creek and two intermittent streams located in the study area. Ingram Creek flows in a northerly and northwesterly direction in the central portion of the area of investigation. The two intermittent streams flow in a westerly direction into Ingram Creek in the northern portion of the area of investigation.

4.2.2 Hydrogeology

During soil boring and well installation activities, groundwater was encountered at depths ranging from approximately 5 feet to 30 feet bgs (Appendix B). Based on groundwater level data collected at the site on January 8, 2002 (Table 3-5), a groundwater elevation map was constructed (Figure 4-2). The water table underlying the site appears to mirror the overlying topography. The overall direction of groundwater flow is to the north-northwest along Ingram Creek.

5.0 Summary of Analytical Results

The results of the chemical analysis of samples collected at the Ranges South of Range 25 indicate that metals were detected in the various site media. Explosive compounds were not detected in any of the samples collected. To evaluate whether the detected constituents present an unacceptable risk to human health and the environment, the analytical results were compared to the human health SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC.

Metals concentrations exceeding the SSSLs and ESVs were subsequently compared to metals background screening values to determine if the metals concentrations are within natural background concentrations (SAIC, 1998). Summary statistics for background metals samples collected at FTMC are included in Appendix H.

The following sections and Tables 5-1 through 5-5 summarize the results of the comparison of detected constituents to the SSSLs, ESVs, and background screening values. Complete analytical results are presented in Appendix F.

5.1 Surface and Depositional Soil Analytical Results

Twenty-two surface soil samples and eight depositional soil samples were collected for chemical analyses at the Ranges South of Range 25. Surface and depositional soil samples were collected from the uppermost foot of soil at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs, ESVs, and metals background screening values as presented in Table 5-1.

Metals. Twenty-two metals were detected in surface and depositional soil samples collected at the site. The concentrations of eight metals (aluminum, antimony, arsenic, chromium, iron, manganese, thallium, and vanadium) exceeded SSSLs. Of these metals, aluminum (at six locations), antimony (HR-226Q-MW04 and HR-226Q-MW05), chromium (HR-224Q-DEP01), iron (HR-224Q-DEP01 and HR-226Q-DEP01), and manganese (HR-227Q-GP01 and HR-227Q-GP02) also exceeded their respective background concentrations. With the exception of antimony in two samples, the concentrations of these metals were within the range of background values (Appendix H). Antimony concentrations (4.38 and 4.41 milligrams per kilogram [mg/kg]) exceeded the SSSL (3.11 mg/kg) and upper background range (2.6 mg/kg) at sample locations HR-226Q-MW04 and HR-226Q-MW05. Both results were flagged with a "J" data qualifier, indicating that the metal was positively identified but the concentrations were estimated.

The concentrations of 13 metals (aluminum, antimony, arsenic, barium, beryllium, chromium, iron, lead, manganese, mercury, thallium, vanadium, and zinc) exceeded ESVs. The concentrations of these metals were either below their respective background concentrations or within the range of background values (Appendix H) except for the following:

- Antimony (4.38 and 4.41 mg/kg) exceeded its ESV (3.5 mg/kg) and upper background range (2.6 mg/kg) in two samples; both antimony results were flagged with a "J" data qualifier indicating that the concentrations were estimated.

- Beryllium (1.14 to 1.64 mg/kg) exceeded its ESV (1.1 mg/kg) and upper background range (0.87 mg/kg) in five samples.

- Lead (135 mg/kg) exceeded its ESV (50 mg/kg) and upper background range (83 mg/kg) in one sample (HR-226Q-GP02); the lead result was "J"-flagged.

5.2 Subsurface Soil Analytical Results

Twenty-two subsurface soil samples were collected for chemical analysis at the Ranges South of Range 25. Subsurface soil samples were collected at depths greater than one foot bgs at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-2.

Metals. Twenty-three metals were detected in subsurface soil samples collected at the site. The concentrations of eight metals (aluminum, antimony, arsenic, chromium, iron, manganese, thallium, and vanadium) exceeded SSSLs. Of these metals, aluminum (11 locations), antimony (three locations), arsenic (four locations), chromium (three locations), iron (four locations), manganese (five locations), and vanadium (HR-227Q-GP02) also exceeded their respective background concentrations. However, the concentrations of these metals were within the range of background values with the following exceptions:

- Aluminum (29,700 to 32,800 mg/kg) exceeded its SSSL (7,803 mg/kg) and upper background range (24,600 mg/kg) in three samples.

- Antimony (4.23 to 6.21 mg/kg) exceeded its SSSL (3.11 mg/kg) and background concentration (1.31 mg/kg) in three samples; the antimony results were "J"-flagged.

- Chromium (66.1 mg/kg) exceeded its SSSL (23.2 mg/kg) and upper background range (55 mg/kg) in one sample (HR-227Q-GP02).
- Iron (50,000 and 56,300 mg/kg) exceeded its SSSL (2,345 mg/kg) and upper background range (48,000 mg/kg) in two samples; the iron results were "J"-flagged.

5.3 Groundwater Analytical Results

Five groundwater samples were collected for chemical analysis at the Ranges South of Range 25, at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-3.

Metals. Ten metals were detected in groundwater samples collected at the site. The concentrations of four metals (aluminum, barium, iron, and manganese) exceeded SSSLs. With the exception of aluminum in one sample, the concentrations of these metals were below their respective background concentrations. The aluminum result, however, was within the range of background values (Appendix H).

5.4 Surface Water Analytical Results

Five surface water samples were collected for chemical analysis at the Ranges South of Range 25 at the locations shown on Figure 3-1. Analytical results were compared to recreational site user human health SSSLs, ESVs, and metals background screening values, as presented in Table 5-4.

Metals. Ten metals were detected in surface water samples collected at the site. The metals results in the surface water samples were below SSSLs. The concentrations of four metals (aluminum, barium, beryllium, and manganese) exceeded ESVs. With the exceptions of barium (three locations) and beryllium (HR-224Q-SW/SD01), the concentrations of these metals were below their respective background concentrations. The barium and beryllium results, however, were within the range of background values (Appendix H).

5.5 Sediment Analytical Results

Five sediment samples were collected for chemical and physical analyses at the Ranges South of Range 25, at the locations shown on Figure 3-1. Analytical results were compared to recreational site user human health SSSLs, ESVs, and metals background screening values, as presented in Table 5-5.

Metals. Eighteen metals were detected in sediment samples collected at the site. The metals results in the sediment samples were below SSSLs. The concentrations of five metals (arsenic, chromium, copper, lead, and nickel) exceeded ESVs and their respective background concentrations. However, only arsenic in one sample exceeded its upper background range (Appendix H). The arsenic result (43.9 mg/kg), which was flagged with a "J" data qualifier, exceeded its ESV (7.24 mg/kg) and upper background range (20 mg/kg) in the sample collected at HR-224Q-SW/SD03.

Total Organic Carbon. The sediment samples were analyzed for total organic carbon content. Total organic carbon concentrations in sediment ranged from 13.4 to 118 mg/kg.

Grain Size. The results of grain size analysis for the sediment samples are included in Appendix F.

5.6 Preliminary Risk Assessment

A preliminary risk assessment (PRA) was performed to further characterize the potential threat to human health from exposure to environmental media at the Ranges South of Range 25, Parcels 224Q, 226Q, and 227Q. The PRA approach was developed at the request of EPA and ADEM to provide a fast and inexpensive estimation of risk for relatively simple sites. It was derived from the streamlined risk assessment (SRA) protocol developed for FTMC and documented in the installation-wide work plan (IT, 1998). A PRA is a simplified version of an SRA, differing primarily in that the maximum detected concentration (MDC) rather than an estimate of average is adopted as the source-term concentration for use in the risk assessment. However, a PRA cannot be less conservative (protective) than an SRA and is generally more protective. The PRA for the Ranges South of Range 25 is included as Appendix I. It discusses the environmental media of interest, selection of site-related chemicals, selection of chemicals of potential concern (COPC), risk characterization, and conclusions.

The foundation of the SRA (and the PRA) is the SSSL, which incorporates all the exposure and toxicological assumptions and precision of a complete baseline risk assessment. SSSLs are receptor-, medium- and chemical-specific risk-based concentrations that are used to screen media to select COPCs and to characterize the risk, i.e., compute the incremental lifetime cancer risk (ILCR) and hazard index (HI) for noncancer effects associated with exposure to the media at the site.

The SSSLs applied to a given site represent the most highly exposed receptor scenario for each of several plausible uses for the site. Both the residential and recreational site user receptor scenarios were evaluated for the Ranges South of Range 25. COPCs were selected from the site-related chemicals identified in the previous sections by comparing the MDC of the site-related chemical with the appropriate SSSL. Chemicals that were identified as not being site-related were dropped from further consideration because their presence was not attributed to site activities. COPCs selected in this manner are the chemicals in each medium that may contribute significantly to cancer risk or to the potential for noncancer effects. As noted above, the MDC was selected as the source-term concentration for use in risk characterization. ILCR and HI values were estimated for each COPC in each medium and were summed to obtain total ILCR and HI values for each receptor.

No COPCs were selected for recreational site user exposure to site media. COPCs selected for residential exposure were limited to metals in soils and groundwater. The PRA concluded that exposure to site media is unlikely to pose an unacceptable threat to human health in either the residential or recreational site user receptor scenarios.

6.0 Summary, Conclusions, and Recommendations

Under contract to the USACE, IT completed an SI at the Ranges South of Range 25 at FTMC in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site at concentrations that present an unacceptable risk to human health or the environment. The SI consisted of the sampling and analysis of 22 surface soil samples, 8 depositional soil samples, 22 subsurface soil samples, 5 groundwater samples, 5 surface water samples, and 5 sediment samples. In addition, six permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information. However, one of the six wells did not produce sufficient water for sampling.

Chemical analysis of samples collected at the Ranges South of Range 25 indicates that only metals were detected in site media. Explosive compounds were not detected in any of the samples collected at the site. Analytical results were compared to the SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC. Additionally, metals concentrations exceeding SSSLs and ESVs were compared to medium-specific background screening values (SAIC, 1998). A PRA was also performed to further characterize the potential threat to human health.

The potential threat to human receptors is expected to be low. Although the site is projected for passive recreation reuse, the analytical data were evaluated against a residential reuse scenario to determine if the site is suitable for unrestricted land reuse. COPCs were limited to metals in soils and groundwater for the residential reuse scenario. No COPCs were selected for the recreational site user scenario. The PRA concluded, however, that exposure to site media does not pose an unacceptable risk for either the resident or the recreational site user.

Constituents of potential ecological concern were limited to three metals (antimony, beryllium, and lead) in surface soils and one metal (arsenic) in one sediment sample. Antimony was detected at estimated concentrations (4.38 and 4.41 mg/kg) marginally exceeding its ESV (3.5 mg/kg) and upper background range (2.6 mg/kg) in two surface soil samples. Antimony was not detected in the remaining 28 surface and depositional soil samples. Beryllium concentrations (1.14 to 1.64 mg/kg) marginally exceeded its ESV (1.1 mg/kg) and upper background range (0.87 mg/kg) in five surface soil samples. It is likely that the beryllium results reflect naturally occurring levels. Lead (135 mg/kg) exceeded its ESV (50 mg/kg) and upper background range (83 mg/kg) in only one of 30 surface and depositional soil samples. Statistically, one elevated lead result out of 30 samples is not representative of nominal site-wide levels. In sediment, arsenic was detected at an estimated concentration (43.9 mg/kg) exceeding its ESV (7.24 mg/kg) and upper background range (20 mg/kg) in one sample. Based on the relatively small magnitude of the exceedances and/or limited spatial distribution in site media, these metals are not expected to pose a threat to ecological receptors.

Based on the results of the SI, past operations at the Ranges South of Range 25 do not appear to have adversely impacted the environment. The metals detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, IT recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste for the area of investigation at the Ranges South of Range 25, Parcels 224Q, 226Q, and 227Q.

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ATTACHMENT 1

LIST OF ABBREVIATIONS AND ACRONYMS

APPENDIX A

SAMPLE COLLECTION LOGS AND ANALYSIS REQUEST/CHAIN-OF-CUSTODY RECORDS

SAMPLE COLLECTION LOGS

ANALYSIS REQUEST/CHAIN-OF-CUSTODY RECORDS

APPENDIX B

BORING LOGS AND WELL CONSTRUCTION LOGS

BORING LOGS

WELL CONSTRUCTION LOGS

APPENDIX C

WELL DEVELOPMENT LOGS

APPENDIX D

SURVEY DATA

APPENDIX E

VARIANCE REPORTS

APPENDIX F

SUMMARY OF VALIDATED ANALYTICAL DATA

APPENDIX G

QUALITY ASSURANCE REPORTS FOR ANALYTICAL DATA

APPENDIX H

SUMMARY STATISTICS FOR BACKGROUND MEDIA, FORT McCLELLAN, ALABAMA

APPENDIX I

PRELIMINARY RISK ASSESSMENT